NECAP Science—Unifying Themes
- - Six Classroom Perspectives on Understanding of Science

Modified from Karin Hess, Center for Assessment, working draft 2005

The science concepts addressed by the NECAP Science Assessment can be classified into six Unifying Themes, or big ideas of science. These categories appear in many national science standards documents and represent broad ways of thinking about science (in any content area), rather than specific theories or discoveries. (pg. 261—*Benchmarks for Science Literacy*) A summary of these six Unifying Themes follows.

Scientific Inquiry (INQ)—This theme is far more flexible than the rigid sequence of steps commonly depicted in textbooks as 'the scientific method.' It is much more than just 'doing experiments.' Inquiry also refers to the activities of students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world—through the ability to question, hypothesize, predict, design and critique investigations, conduct investigations, collect, organize and interpret data, use evidence to draw conclusions and communicate understanding. (p. 23 *National Science Education Standards*)

Nature of Science (NOS)—This theme addresses an understanding of how science 'works,' the process of science. Instruction of this theme may include understandings of the tools and technology necessary for scientific investigation, how theories are modified when application of new evidence and reasoning, how scientists build on the work of others and the attitudes and dispositions of science (avoiding bias, divergent ideas, healthy skepticism).

Systems and Energy (SAE)—This theme involves the ability to think about a whole in terms of its parts, and about parts and how they relate to one another as well as the whole. The concept of energy is often used to analyze how systems function. Student learning here includes order and organization, interactions, interdependence, equilibrium, energy transfer and cycles. (pgs. 3-4 *Benchmarks for Science Literacy*)

Models and Scale (MAS)—Models are a very effective tool for leaning about many ideas in science. Whether models are physical, mathematical, or conceptual, their usefulness as an instructional device lies in suggesting how things either do work or might work. A more sophisticated concept includes the effect of changes in scale. Student learning involves experience with models, proportions, magnitude, relationships and relativity.

Patterns of Change (POC)—Much of science involves understanding how change occurs in nature and in social and technological systems. This unifying theme also involves controlling change. Student learning would focus on cycles, constancy and change, and evolutionary change.

Form and Function (FAF)—Form and function are complementary aspects of objects, organisms and systems in the natural and designed world. Instruction of this theme may focus on understanding of form and function in both the natural and designed world. Form and function as it relates to engineering design would need to be assessed locally.

Table 1.1:
Conceptual Matrix - Developing/Prioritizing Assessment Targets for NECAP Science Assessment

Unifying Themes/Big Ideas of Science
(Subheadings under each Unifying Theme/Big Idea suggest but are not limited to what might be addressed.)

Scientific Inquiry	**Nature of Science**	**Systems & Energy**	**Models & Scale**	**Patterns of Change**	**Form & Function**
• Collect data • Communicate understanding & ideas • Design, conduct, & critique investigations • Represent, analyze, & interpret data • Experimental design • Observe • Predict • Question and hypothesize • Use evidence to draw conclusions • Use tools, & techniques	• Accumulation of science knowledge (evidence & reasoning, looking at work of others) • Attitudes and dispositions of science (avoiding bias, divergent ideas, healthy skepticism) • History of Science • Science/Tech/ Society • Scientific Theories	• Cycles • Energy Transfer • Equilibrium • Interactions • Interdependence • Order & Organization	• Evidence provided through… • Explanations provided through… • Relative distance • Relative sizes *Models include - experimental models, simulations, & representations used to demonstrate abstract ideas*	• Constancy and Change • Cycles • Evolutionary Change	• Natural World • Designed World